1 Introduction

Taking private action, such as any investment of capital, requires information[1]. Prior information helps audiences make better use of new information. The more one initially knows about an issue, the better they can utilize new information about this issue, and in turn the higher possibility that they would take correct action, the higher profits involved. Suppose each audience can get information about an issue from directly reading newspapers and/or discussing with individuals who already know about it. Based on these assumptions, a simple model is built to analyze the coverage strategies of newspapers. Our results show that newspapers collectively tend to report on the same issue (issue bias). This shared bias is possibly not in line with that of larger group of partisans.

We provide an insight to the growing literature on where media bias comes from. Existing literature provides two origins of media bias: supply-driven (Besley and Prat 2006, Corneo 2006, Petrova 2008, Baron 2006 and Druckman et al. 2005) and demand-driven. Strömberg (2004) demonstrated that "media biases policy against minority interests" because of the increasing return to scale of newspapers. Mullainathan and Shleifer (2005) assumed that heterogeneous readers prefer news which is consistent with their previous bias. Newspapers separately bias toward each segment. Through analysis of U.S. daily newspaper, Gentzkow and Shapiro (2010) argued that medias significantly respond to consumer preferences which are the like-minded news. We show that newspapers collectively trend toward sharing a same bias even in a heterogeneous market.

Non-partisan audiences are incorporated in our analysis. Most current studies from the demand-driven perspective have been devoted to partisan audience. Any audience, before acquiring partisanship, is a non-partisan. Our results show that newspapers are more likely to bias away from the major group of partisans when the proportion of non-partisans increases. This is because the coverage of newspapers affects the preference of non-partisans, although it is in turns affected by that of partisans. On the other hand, in order to increase demand from non-partisans, newspapers tend to show extreme bias.

Moreover, this "shared bias" introduces a risk that more valuable information is excluded from the market. Audiences prefer to know more about issues with higher marginal utility. However, the marginal utility gained from knowing about one issue increases with the increase of information that has been known about this issue. This may keep them from recognizing the possibly more valuable issue. If major partisans prefer to read information about an inferior issue, newspapers are more likely to only report on this inferior issue.

This collective failure may shed light on elections. Consider a case in which voters are

[1] A similar assumption of "consumption requires knowledge" is made by Adler (1985).

more interested in issues of economic reform, rather than political reform, just because they have already acquired much more information about economic reform. In order to obtain more votes, politicians compete to develop proper policies in economics reform. However, it is possible that in reality the issue of political reform is more urgent and more important. Developing proper policies in political reform might bring more benefits to voters.

2 Model

Two newspapers, A and B, compete for the audience by determining an optimal allocation of coverage space between issues α and β. α and β refer to two specific topics or two types of topics, e.g. economic and political issue. The space that newspaper i assigns to issue α is denoted as $1/2 + \xi_i$, $\xi_i \in [-1/2, 1/2]$, $i = A, B$. The total space of each newspaper is identical to 1 for simplicity. Correspondingly, the space spent to β issue is $1/2 - \xi_i$. The amount of information expressed in unit space is the same.

Suppose $U(x_\alpha, x_\beta)$ is an individual's utility from taking private action, while x_α and x_β are the amount of information that he knows about α and β issues. We assume $U'_{x_\alpha} > 0$, $U'_{x_\beta} > 0$, $U''_{x_\alpha} > 0$ and $U''_{x_\beta} > 0$. In other terms, the more information an individual knows about one issue, the higher possibility that he takes correct private action, thereby the more utility he obtains. These features of utility function do not refer to news in general, but to the news in question. Issue α is considered to be more, equally, or less valuable than issue β, if $U(x_\alpha, 0) \gtreqless U(0, x_\beta)$ when $x_\alpha = x_\beta$.

There is a continuum of audiences of unit mass, which are divided into 3 groups according to the information they know of at the beginning of the game. We refer to an individual as pro-α partisan, non-partisan, or pro-β partisan if $U'_{x_\alpha}(x^*_\alpha, x^*_\beta) \gtreqless U'_{x_\beta}(x^*_\alpha, x^*_\beta)$, while x^*_α and x^*_β are the initial amount of information about α and β. Suppose partisans account for ω, in which the fraction of pro-α is $1/2 + \eta$, $\eta \in [-1/2, 1/2]$, $\omega \in (0, 1)$. Pro-α and pro-β account for $\omega(1/2 + \eta)$ and $\omega(1/2 - \eta)$ respectively. For simplicity, we assume $\eta > 0$, namely pro-α are the major partisans.

The timing of the game is as follows.

Step 1. Two newspapers simultaneously decide the amount of space to designate to each issue (determination of ξ_i).

Step 2. The audiences observe the decision of newspapers (ξ_i), decide which newspaper to buy, and then take private action.

Image audiences have a chance to glance over the front page of two newspapers, before choosing a newspaper. Audiences can not read details of each issue while skimming through, but can observe the space distribution of each newspaper (ξ_i). We assume that any newspaper spends more space on one issue in the front paper if it spends more space on this issue. Each individual only buys one newspaper. We suppose that time, compared to the negligible pecuniary cost of newspapers, is the main cost to the audience. Time is limited, with regard to the total amount of information in two newspapers.

Newspapers are "experience goods". Before reading it, audiences can not judge which newspaper will provide them with more utility. Thus, audiences intend to choose the newspaper which reports more on the issue which provides them with higher marginal utility.

3 Analysis

3.1 Audiences' choice

It is obvious that the pro-α choose the newspaper which conveys more information about α, while pro-β choose the opposite. When $\xi_A = \xi_B$, the audiences choose either one. However, the choice of the non-partisan is not fixed. It depends on which issue the non-partisan first access. Non-partisans prefer the first-access issue. If a non-partisan first accesses issue α, the marginal utility from knowing α increases ($U''_{x_\alpha} > 0$) while the marginal utility from knowing β stays the same (x_β stays the same), and vice versa. This non-partisan will not become a consumer of β. Then, how to determine which issue that a non-partisan may first access?

We propose that there are two ways to access information, from newspapers and from knowledgeable individuals. A non-partisan may access α or β while glancing over headlines in front pages or discussing with partisans. It is easier to access one issue if this issue is conveyed in large amount and/or this issue is already known by many individuals. From this, we derive the possibility that a non-partisan first accesses α, P_α, is $[1+\xi_A+\xi_B+\omega(1/2+\eta)]/(2+\omega)$, in which $1+\xi_A+\xi_B$ is the possible amount of α issue from newspapers, $\omega(1/2+\eta)$ is the fraction of pro-α. Similarly, $P_\beta = [1-\xi_A-\xi_B+\omega(1/2-\eta)]/(2+\omega)$. Non-partisans choose the newspaper which spend more space on α with the possibility of P_α, and choose the opposite with $1-P_\alpha$.

It is obvious that initial access is determined by the environment in which the amount of each issue is decided by newspapers while the fraction of partisans is given. From this sense, the collective coverage of newspapers affects non-partisans' choices through affecting the possibility that they initially access α or β.

3.2 Newspapers' choice

Newspaper i decides ξ_i to maximize its own profit. Denote the profit of newspaper i as π_i, $\pi_i = (p - mc)D_i - fc$; p, mc, D_i, fc are respectively its price, marginal cost, demand and the set-up cost. Suppose $p = 1$, $mc = 0$, $fc = 0$ for simplicity. Then $\pi_i = D_i$. We consider D_i as an indirect payoff function of newspaper i. D_i is the sum of demand from pro-α, pro-β, and the non-partisan. The demand function for each newspaper is as follows.

Case I *If* $\xi_A > \xi_B$, $D_A = (1-\omega)P_\alpha + \omega(1/2 + \eta)$, $D_B = (1-\omega)P_\beta + \omega(1/2 - \eta)$.

Case 2 *If* $\xi_A < \xi_B$, $D_A = (1-\omega)P_\beta + \omega(1/2 - \eta)$, $D_B = (1-\omega)P_\alpha + \omega(1/2 + \eta)$.

Case 3 *If* $\xi_A = \xi_B$; $D_A = D_B = 1/2$.

Since the demand functions are determined only by the decision of newspapers and the payoff functions are common knowledge, this game can be simplified as a statistic game of complete but imperfect information, more specifically, a "Bertrand Game", in which ξ_i can be considered as "price".

Proposition *$(1/2,\ 1/2)$ and $(-1/2,\ -1/2)$ are the only two Nash Equilibria.*

Proof. Newspaper i's best response is $\xi_i = \begin{cases} 1/2 & \text{if } \xi_{-i} > \widetilde{\xi}_{-i} \\ 1/2, -1/2 & \text{if } \xi_{-i} = \widetilde{\xi}_{-i} \\ -1/2 & \text{if } \xi_{-i} < \widetilde{\xi}_{-i} \end{cases}$, $\widetilde{\xi}_{-i} = 3\omega\eta/(\omega - 1)$.

From Figure 1, in which the gray and red lines represent the best response of newspaper B and A separately, we know that $(1/2, 1/2)$ and $(-1/2, -1/2)$ are the equilibria.

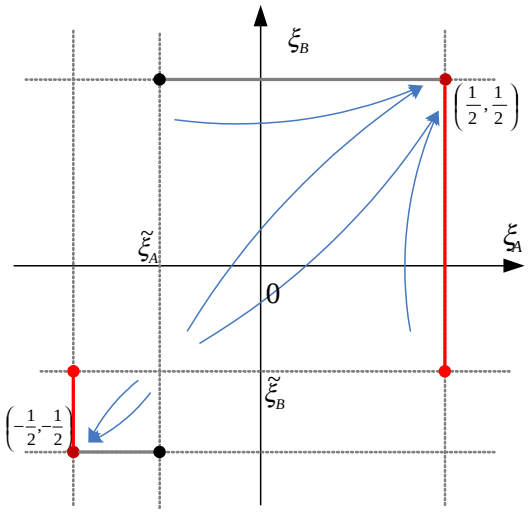

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Figure 1 The best response of both newspapers

This proposition shows three results:

1) Each newspaper extremely biases toward one of the issues. In equilibrium, each newspaper's coverage strategy is $1/2$ or $-1/2$. Actually, this extreme bias shows a clear focus to attract the partisan. Moreover, it increases the chance that the non-partisan accesses its focused issue before all others, and in turn increases the demand from the non-partisan. From this sense, competition between independent newspapers enhances bias.

2) Two newspapers tend to share the same bias. $(1/2, 1/2)$ and $(-1/2, -1/2)$ respectively represent the cases in which newspapers collectively report on issue α and β. Beside reading newspapers, non-partisans gain information from discussing with partisans. If newspapers bias toward different issues, non-partisans can access one issue more easily when the size of each partisan subgroup is not even. The newspaper which biases away from the majority of partisans will lose the major market, both of the partisan and non-partisan. Therefore, in equilibrium, media outlets concentrate on the same issues and split the market evenly.

3) Moreover, it is possible that this shared bias differs from that of the prior majority of partisan audience. Newspapers are more likely to bias toward the major partisans. However, when the fraction of non-partisans increases (ω decreases), the possibility of biasing toward the minor subgroup increases ($\widetilde{\xi}_i$ increases). It is because the collective strategy of newspaper affects the issue preference of non-partisans. This situation is shown in Figure 1.

This shared bias generates a risk in which the more valuable issue is excluded from the newspaper market. Even in the case that β exceeds α, newspapers are more possible to only report issue α ($\widetilde{\xi}_i < 0$). This is because audiences' preference among issues is affected by their experience. Newspapers may concentrate on an inferior issues because major audiences prefer it, since they know more of it. Through reading newspaper, non-partisans is more likely to gain the preference for this inferior issue. In the long run, other superior issues may be excluded from the market. From this sense, the shared bias of newspaper introduces a collective failure.

4 Conclusion

Our paper presents an idea that even in the market of heterogeneous audiences, newspapers collectively trend toward sharing the same bias among issues, which is possibly not in line with that of the major partisans. Moreover, this shared bias introduces a risk that more valuable information is excluded from the newspaper market.

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